Description of Scenario 1A, Community Resiliency to Wildfire

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This Scenario indirectly assesses the risk to communities (or population density) by wildfire and potential to reduce that risk by fuel treatments and resource benefit fire in the vicinity.

Population Density - Communities at risk are represented by population density, instead of communities (which can be variable in size) or WUI (Wildland Urban Interface) which is also highly variable. The population density data estimates were computed from the U.S. Department of Commerce Census Bureau's block group and block data for 2000 and refined for 2000 data and projected for 2030 (Stein et al. 2007). (http://www.fs.fed.us/pnw/publications/gtr728/gtr728b.pdf)

Population density for 2000 and 2030 in 3 classes, below, are summarized for each 6th code HUC:
- **Rural I** (lands with 16 or fewer housing units per square mile).
- **Rural II** (17 to 64 housing units per square mile).
- **Exurban/urban** (65 or more housing units per square mile).

Feasibility – CWPP's and Response to Wildland Fire

Community Wildland Fire Protection Plans (CWPP) are created by each county. Where CWPP's are completed, there are greater chances of accomplishing fuel treatments due to greater funding opportunities for CWPP projects. This increased chance for funding opportunities is interpreted into increased feasibility that fire risk, or burn probability, can be reduced in areas adjacent to CWPP's.

Unplanned ignitions also have the potential to provide fire breaks or reduced fuel or fire severity. This has the potential to reduce fire risk to adjacent communities. The Response to Wildland Fire areas are tied to the individual forest Land Management Plan direction and Response Guides. These areas have the potential for wildfire decisions that can positively influence the feasibility that fire risk can be reduced. These areas are mapped according to individual forest plan allowances and summarized by 6th HU Codes. The benefits can be ecological, based on desired conditions for wildlife habitat, hydrology, soils, etc. reflected in the forest plan (see Scenario 1b). They can also be fuel reduction to help reduce the severity of fire impacts to other resources. When overlaid with other habitat features, the benefits can be quantified.

Risk – Burn Probability

Risk from wildfire was estimated using burn probability to identify areas with higher chances of crown fire relative to surrounding areas. The burn probability map is a product of the Mark Finney's Large Fire Simulator (FireSim, which is similar to FSPro) resulting in simulation outputs of fire line intensity and fire probability by cell. Simulations of thousands of fires over 10,000 years are made using FireSim.

Data Used - Data required for input to the simulation process include GIS-format fuels and topography (from LandFire Rapid Refresh), daily historic weather data from 10-20 years and historic ignition date and locations. All fires reported and available through FAMWEB (http://fam.nwcg.gov/fam-web/) for USFS, FWS, and NPS lands (no private) within the landscape were used to develop a regression based

on ERC and to the number of large fires and multiple fire days. All fires greater than 300 acres were considered large fires. The spatial data used is rapid refresh data updated for fires up to and through 2007 that was re-projected to a local projection. Runs were processed on the super computers at the fire lab.

The forest part of the Region (from the Custer NF westward) was-modeled as one modeling unit. This was due to edge-matching problems when smaller portion of the Region were run separately. This run used weather data from only one weather station in Missoula, due to limitations of the model at that point in development. Future runs on the newer version of the model will enable the use of data from many weather stations.

For the rest of the Region, FPA (Fire Planning Analysis) runs of the FireSim model were used. These runs were made using local weather stations in each FPU (Fire Planning Unit). There were edge matching problems with these runs. The runs for North Dakota were not available at the time of data acquisition, so were extrapolated from data in surrounding areas. There have been subsequent updates to the FireSim model that will accommodate more weather station data.

Data Outputs - The output from these runs created a table of flame lengths which were then manipulated to create classes of surface fire and crown fire. We overlaid the flame length gird with the crown cover layer of the landscape file. Areas with any crown cover greater than 10 percent, fuel models greater 160 **and** flame lengths 2 meters or greater were classified as crown fire probability. All other flame lengths were designated as surface fire. The crown fire probability was averaged for each 6th code HUC and the percent of the HUC area in the crown fire class were calculated. The same procedure was followed for the Ground Fire with forest and Ground Fire without forest.

The probabilities (not predictions or forecasts) are annual probabilities of a fire occurring and are additive. We can add the probabilities for the years up. BUT, we MUST qualify that the probabilities are on average. So you can say with 2% probability per year, over 10 years you have a 20% chance of burn ON AVERAGE.

The probability is not conditional - chance of fire this year does not change the fuel model (or fire) for the next year. We would have to update the landscape spatial data (.lcp) file to reflect that and rerun the model to capture that impact. There are also no long-term vegetation interactions or influence of drought. There are no fires spreading into the area from outside the edges of the map. Many factors result in fire probabilities on the lower end of the scale.

Burn Probability and Fire Behavior - Map outputs for burn probability represent an estimate of the spatial variability in probability of burning from large fires. Highest burn probabilities are found at the low elevations because grass fuels dominate in these locations. Expected flame lengths are relatively low in these fuel types. Areas of conifer forests and at high elevation tend to have lower burn probabilities because timber fuels have lower spread rates. However, expected flame lengths in these fuel types are higher because they are more likely to burn as crown fires under the weather circumstances that allow them to burn.

Spatial locations of large fires are assumed random, but if data were available, would be spatially variable. Once started, large fire growth was simulated using the sequence of daily values of fuel moisture and wind speed from the synthetic weather stream (starting with the date of occurrence). The

duration of fire growth was entirely determined by the sequence of weather days in the artificial time series following the day of ignition (*i.e*. not set *a priori*) and by a suppression model (see below). A Minimum Travel Time (MTT) algorithm performs the fire growth by searching for the shortest fire travel times among cells on a landscape. This method is computationally efficient in simulating fire growth under complex environmental conditions. It calculates fire behavior at each "cell" (e.g. flame length) on a landscape which is necessary for determining fire effects.

Large-Fire Suppression - A statistical model of large-fire suppression was developed which relies on historic large-fire records. This model predicts the probability of containment as a function of time periods of fire activity (series of days which the fire grew vs. those which it stayed relatively constant). Containment was found to be more likely when the fire grew slowly, after an increasing number of time periods of slow fire growth, and in non-timber fuels. Containment probability produced by the model was included in the simulation system and was applied to the daily sequence of weather events. For each period in a weather sequence, a containment probability produced by the model is used by the prototype to stochastically estimate the reduced number of days that fire growth occurs. This limits the sizes of most fires, but fires that started near the end of the seasons will be little influenced by suppression whereas fires beginning early in the season were probably greatly affected.

Appendix

Literature Cited

Stein, SM, R.J. Alig, E.M. White, S.J. Comas, M.Carr, M. Eley, K. Elverum, M. O'Donnell, D.M. Theobald, K Cordell, J. Haber and T. W. Beauvais. 2007. National Forests on the edge, Development pressure on America's National Forests and Grasslands. PNW-GTR-728.

Finney, M. A., C.W. McHugh, I.C. Grenfell and K.L. Riley. 2010. A Simulation of Probabilistic Wildfire Risk Components for the Continental United States. Draft 4/1/2010. USDA Forest Service, Missoula Fire Sciences Laboratory, 5775 Highway 10 West, Missoula, MT 59808. 62 pp.